CLAIMS

What is claimed is:

1. A communication link for providing two-way communication through free space, the link including a first transceiver and a second transceiver, wherein at least one transceiver comprises:

an input signal interface for receiving a digital signal;

a splitter in communication with the input to split the digital signal into a plurality of approximately equal laser data signals;

a plurality of lasers displaced from one another and facing in parallel directions, each of the lasers being in communication with the splitter;

a plurality of laser drivers, each laser driver being coupled to one of the lasers and to the splitter, wherein the laser drivers receive the laser data signals and provide amplified laser data signals to the lasers at high power and high frequency.

2. The communication link of claim 1, wherein the input signal is characterized by a data rate of at least 10 Mbits/second, and each laser is supplied with a nominal current of at least 100 mA.

3. The communication link of claim 1, wherein said at least one transceiver further comprises an input signal regenerator in communication with the one or more digital input signals.

4. The communication link of claim 3, wherein the input signal regenerator includes a first clock and data recovery circuit which is switchable between one of a plurality of clock frequencies.

5. The communication link of claim 1, wherein each of the plurality of lasers includes a laser diode coupled to the laser driver and receiving the amplified laser data signals.

6. The communication link of claim 5, wherein each of the plurality of lasers further includes a lens for receiving and collimating the laser diode output into an optical beam.

7. The communication link of claim 6, wherein the beamwidth of the optical beam is adjustable.

8. The communication link of claim 7, wherein the beamwidth of the optical beam is adjustable between from 0.3 mrad to approximately 3.5 mrad.

9. The communication link of claim 6, wherein the beamwidth of the optical beam is less than 3.5 mrad.

10. The communication link of claim 5, wherein the laser driver includes a modulation signal amplifier coupled with the splitter and a DC bias circuit coupled between the modulation signal amplifier and the laser diode.

11. The communication link of claim 10, wherein the laser driver further includes a sampling photodiode, wherein the modulation signal amplifier is coupled with the sampling photodiode and responsive to the output of the sampling photodiode.

12. The communication link of claim 11, wherein the laser diode emits a laser beam, and the sampling photodiode monitors the power of the laser beam.

13. The communication link of claim 5, wherein said at least one transceiver further comprises a thermoelectric cooler in thermal communication with the laser diode.

14. The communication link of claim 5, wherein the laser driver operates at a current of between approximately 100 milliAmperes and 1500 milliAmperes.

15. The communication link of claim 5, wherein the laser diode generates an average power of at least 80 milliwatts.

16. The communication link of claim 1, wherein the digital signal a comprises packet-based communication signal in accordance with a data transmission protocol.

17. The communication link of claim 16, wherein the data transmission protocol complies with a protocol selected from the group consisting of TCP/IP, IPX, Fast Ethernet, SONET, and ATM.

18. The communication link of claim 1, wherein the transceiver is capable of operating on at least one layer selected from the group consisting of STS-3, STS-12, OC-3, and OC-12.

19. The communication link of claim 1 wherein said at least one transceiver further comprises:

an aperture;

a reflector in line with the aperture;

a photodiode at the focal point of the reflector; and

an output from the photodiode.

20. The communication link of claim 19, wherein the reflector has an f-number of about 0.67

21. The communication link of claim 19, wherein the reflector is a Mangin mirror.

22. The communication link of claim 19, wherein the reflector is a mirror having a general conic, aspheric, or parabolic optical surface that is coupled with one or more corrector lenses.

23. The communication link of claim 19, wherein said at least one laser transceiver further comprises a stray light baffle disposed across the primary aperture.

24. The communication link of claim 19, wherein said at least one transceiver further comprises:

a preamplifier coupled with the photodiode;

an output signal regenerator coupled with the preamplifier; and

an output signal interface coupled with the output signal regenerator.

25. The communication link of claim 24, wherein the output signal regenerator includes a second clock and data recovery circuit which is switchable between one of a plurality of clock frequencies.

26. The communication link of claim 19, wherein said at least one transceiver further comprises a background rejection filter near the focal point of the reflector.

27. The communication link of claim 26, wherein the background rejection filter is a bandpass filter.

28. The communication link of claim 26, wherein the background rejection filter is an optical interference filter and has a nominal center wavelength of approximately 1550 nanometers.

29. The communication link of claim 26, wherein said background rejection filter is a long wave pass filter having a threshold passage wavelength, said at least one transceiver further comprising a detector having a predictable responsivity roll-off at a wavelength above the threshold passage wavelength of the long wave pass filter.

30. The communication link of claim 19, further comprising a radio frequency backup transceiver.

31. The communication link of claim 30, wherein said at least one transceiver includes monitoring circuitry for monitoring signal strength or transceiver status.

32. The communication link of claim 31, wherein the backup transceiver is activated upon detecting impairment of the laser transceiver, and the backup transceiver is deactivated upon detecting non-impairment of the laser transceiver.

33. The communication link of claim 30, wherein said at least one laser transceiver operates with the backup transceiver in overflow mode.

34. The communication link of claim 1, wherein said at least one laser transceiver further comprises a protective enclosure.

35. The communication link of claim 34, wherein said at least one laser transceiver further comprises an environmental control system for maintaining a desired temperature and humidity within the enclosure.

36. The communication link of claim 1, wherein said at least one transceiver further includes a multiplexer to combine multiple signal inputs and a de-multiplexer to segregate multiple signal outputs.

37. A digital signal transceiver comprising:

an input signal interface for receiving a broadband digital signal;

a first regenerator coupled with the input signal interface;

a splitter coupled with the regenerator to split the digital signal into one or more laser data signals;

a high power, high frequency laser driver coupled with the splitter to condition the laser data signals; and

a plurality of lasers coupled with the laser driver to receive the laser data signals, the lasers being laterally displaced from one another and facing in parallel directions.

38. The transceiver of claim 56, wherein the first regenerator includes a first clock and data recovery circuit which is switchable between one of a plurality of clock frequencies.

39. The transceiver of claim 37, wherein each of the plurality of lasers includes a laser diode coupled to the laser driver and receiving the conditioned laser data signals.

40. The transceiver of claim 39, wherein each of the plurality of lasers further includes a lens for receiving and collimating the laser diode output into a beam having a beamwidth of 3.5 mrad or less.

41. The transceiver of claim 39, wherein the laser driver includes a modulation signal amplifier coupled with the splitter and a DC bias circuit coupled between the modulation signal amplifier and the laser diode.

42. The transceiver of claim 41, wherein the laser driver further includes a sampling photodiode, wherein the modulation signal amplifier is coupled with the sampling photodiode and responsive to the output of the sampling photodiode.

43. The transceiver of claim 42, wherein the laser diode emits a laser beam, and the sampling photodiode monitors the power of the laser beam.

44. The transceiver of claim 39, wherein the laser driver further includes a thermoelectric cooler adjacent to the laser diode.

45. The transceiver of claim 39, wherein the laser diode operates at a current of approximately between 100 milliAmperes and 1500 milliAmperes.

46. The transceiver of claim 39, wherein the laser diode generates an average power of at least 80 milliwatts.

47. The transceiver of claim 37, wherein the digital signal comprises packet-based communication signals in accordance with at least one data transmission protocol.

48. The transceiver of claim 47, wherein the at least one data transmission protocol complies with a protocol selected from the group consisting of TCP/IP, IPX, Fast Ethernet, SONET, and ATM.

49. The transceiver of claim 47, wherein the transceiver operates on at least one layer selected from the group consisting of STS-3, STS-12, OC-3, and OC-12.

50. The transceiver of claim 37, further comprising:

an aperture;

a reflector in line with the aperture;

a photodiode at the focal point of the reflector;

a preamplifier coupled with the photodiode;

a second regenerator coupled with the preamplifier; and

an output signal interface coupled with the second regenerator.

51. The transceiver of claim 50, wherein the reflector is selected from the group consisting of a Mangin mirror, a parabolic reflector coupled with a corrector lens, and a mirror having a general conic or aspheric optical surface and coupled with at least one corrector lens.

52. The transceiver of claim 50, wherein the second regenerator includes a second clock and data recovery circuit which is switchable between one of a plurality of clock frequencies.

53. The transceiver of claim 50 further comprising a background rejection filter disposed adjacent to the focal point of the reflector.

54. The transceiver of claim 53, wherein the background rejection filter is an optical hemispherical interference filter having a nominal center wavelength of approximately 1550 nanometers.

55. The transceiver of claim 50, wherein the reflector has an f-number of about 0.67.

56. An apparatus for efficiently driving a laser diode, the apparatus comprising:

a signal source providing an input signal;

a laser diode having a characteristic impedance; and

a power amplifier with a low output impedance suited to drive the laser diode;

wherein the power amplifier is operated as a voltage-controlled current driver for the laser diode.

57. The apparatus of claim 56, further comprising a voltage amplification stage between the signal source and the power amplifier.

58. The apparatus of claim 57, wherein the voltage amplification stage includes a non-linear limiting amplifier.

59. The apparatus of claim 56, wherein the power amplifier includes a broadband RF power field effect transistor.

60. The apparatus of claim 59, wherein the power field effect transistor is selected from the group consisting of MOSFET, silicon FET, and GaAs FET.

61. The apparatus of claim 59, wherein the broadband RF power field effect transistor is capable of operating at a minimum frequency of 1 MHz or less.

62. The apparatus of claim 56, wherein the broadband RF power field effect transistor is operated with a low supply voltage.

63. The apparatus of claim 56, wherein the supply voltage of the power amplifier is approximately equal to or less than 12 volts.

64. The apparatus of claim 56, wherein the supply voltage of the power amplifier is approximately 5 volts.

65. The apparatus of claim 56, wherein the power transistor provides output current of at least 100 mA to the laser diode.

66. The apparatus of claim 65, wherein the input signal is characterized by a data rate of at least 10 Mbits/second.

67. The apparatus of claim 65, wherein the input signal is characterized by a data rate of at least OC-3 bandwidth.

68. The apparatus of claim 56, wherein the power transistor provides output current of at least 200 mA to the laser diode.

69. The apparatus of claim 56, wherein the input signal is a signal selected from a group of protocols consisting of: TCP/IP, IPX, Fast Ethernet, SONET, and ATM

70. The apparatus of claim 56, wherein the laser diode has a characteristic dynamic impedance of between approximately 2 and 5 ohms.

71. The apparatus of claim 56, further comprising a thermoelectric cooler in thermal communication with the laser diode.

72. The apparatus of claim 56, wherein the laser diode is stabilized against temperature fluctuations.

73. The apparatus of claim 56, wherein the power amplifier is stabilized against supply voltage fluctuations.

74. The apparatus of claim 73, further comprising a zener diode for stabilizing power supply voltage against voltage fluctuations.

75. The apparatus of claim 56, further comprising an attenuator between the signal source and the power amplifier.

76. The apparatus of claim 75, wherein the attenuator is adjustable and is used to control the amplitude of the input signal to the power amplifier.

77. The apparatus of claim 56, further comprising:

a temperature sensor for sensing temperature of the laser diode,

a thermoelectric cooler in thermal communication with the laser diode, and

a thermoelectric cooler power amplifier,

wherein the thermoelectric cooler power amplifier is operated as a controlled current source to supply current to the thermoelectric cooler at near-perfect efficiency when maximum cooling is required.

78. The apparatus of claim 77, wherein the temperature sensor is a thermistor.

79. The apparatus of claim 78, wherein the voltage drop across the thermistor at a given temperature is compared to a reference voltage corresponding to the thermistor voltage when it is operated at a desired setpoint temperature.

80. The apparatus of claim 77, wherein the power amplifier is a power FET.